



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Pet-9 Entrance Exam Draft Syllabus Year 2024

Faculty Name	Subject	Syllabus SET/NET/GATE
Faculty of Commerce and Management	Commerce, Management & Accountancy	SET Syllabus
Faculty of Humanities	A.I.H.C & A.	Archeology NET Syllabus
	Economics	SET/NET Syllabus
	English	SET/NET Syllabus
	Hindi	SET/NET Syllabus
	History	SET/NET Syllabus
	Law	SET/NET Syllabus
	Marathi	SET/NET Syllabus
	Political Science	SET/NET Syllabus
	Psychology	SET/NET Syllabus
	Rural Development	M.A. Rural Development Part- I & II Syllabus
	Urdu	SET/NET Syllabus
Faculty of Interdisciplinary Studies	Education	SET/NET Syllabus
	Physical Education	SET/NET Syllabus
Faculty of Science & Technology	Botany	Syllabus Linked
	Chemistry	SET Syllabus
	Civil Engineering	GATE Syllabus
	Computer Science	SET Syllabus
	Computer Science & Engineering	GATE Syllabus
	Electronics	SET Syllabus
	Electronics & Telecommunication Engg.	GATE Syllabus
	Electronics Engineering	GATE Syllabus
	Environment	SET Syllabus
	Geography	SET Syllabus
	Geology	SET Syllabus
	Mathematics	SET Syllabus
	Mechanical Engineering	GATE Syllabus
	Microbiology	Syllabus Linked
	Pharmacy	GPAT
	Physics	SET Syllabus
	Zoology	Syllabus Linked

Dama C.B.
24/2/2024
(Dr. Laxmikant Dama)
Pro-Vice Chancellor



Punyashlok Ahilyadevi Holkar Solapur University, Solapur

PET PAPER II Syllabus for Botany 2023

Unit I: Biology & Diversity of Algae, Fungi, Bryophytes, Pteridophytes & Gymnosperms

- **Algae:** Algae in diversified habitats (terrestrial, fresh water and marine water), thallus organization, Salient features of Algae, Economic Importance of algae.
- **Fungi:** General characters and classification (Ainsworth's 1973 system), Cell ultrastructure and Cell wall composition, nutrition (saprobic, biotrophic, symbiotic), reproduction (vegetative, asexual and sexual), fructification and Spore forming structures, heterothallism, heterokaryosis parasexuality. Economic Importance of Fungi.
- **Bryophytes:** Diversity in Bryophytes with respect to thallus structure, reproduction, life cycle, Salient features of Bryophytes. Economic importance of Bryophytes.
- **Pteridophyte:** Diversity in Pteridophytes with respect to morphology, anatomy, reproduction, Salient features of Pteridophytes, Economic Importance of Pteridophytes.
- **Gymnosperms:** Diversity of Gymnosperms with respect to morphology, anatomy, reproduction, Salient features of Gymnosperms, Economic importance of Gymnosperms

Unit II: Plant Systematics

- **Introduction:** Aims, principles of taxonomy, types of taxonomy, chemotaxonomy, numerical taxonomy, serotaxonomy
- **Tools in taxonomy:** Floras, monographs, revisions, websites. Herbarium and botanical gardens, their role in teaching, research and conservation, steps in herbarium preparation, important herbaria in India.
- **Classification:** Artificial, Natural & Phylogenetic system of classification, Bentham & Hookers system of classification, Cronquist, Takhtajan, APG system of classification features used in identification, citation of authority, rejection of names, priority of publication, ICN Principles.

Unit III: Physiology of Plants

- **Solute transport and photo assimilate translocation:** uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem, transpiration, mechanisms of loading and unloading of photo assimilates.
- **Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; CO₂ fixation-C₃, C₄ and CAM pathways.

- **Respiration and Photorespiration:** Glycolysis, Acetyl CoA formation, Citric acid cycle, plant mitochondrial electron transport and ATP synthesis, alternate oxidase, photorespiratory pathway.
- **Plant Hormones:** Biosynthesis, storage, breakdown and transport, physiological effects and mechanisms of action. Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. Structure, function and mechanisms of action of phytochromes and cytochromes.

Unit IV: Genetics

- **Mendelian Principles:** Dominance, segregation, independent assortment, Codominance, incomplete dominance, gene interactions, pleiotropy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.
- **Concept of gene & Gene mapping methods:** Allele, multiple alleles, pseudoallele, complementation tests, Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.
- **Mutation:** Causes and detection, mutant types, Structural and numerical alterations of chromosomes Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
- **Microbial genetics:** Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

Unit V: Molecular Biology and Plant Biotechnology

- **Molecular Biology:** Structure of DNA and RNA, Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, Analysis of RNA, DNA and proteins by gel electrophoresis, Isoelectric focusing gels. Isolation, separation and analysis of Protein molecules RFLP, RAPD and AFLP techniques. DNA sequencing methods, strategies for genome sequencing.
- **Recombinant DNA methods:** Generation of genomic and cDNA libraries. Phage, cosmid, BAC and YAC vectors. Cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Enzymes involved in recombinant technology, transgenic plants.
- **Plant Tissue Culture:** Introduction to Plant Tissue culture, Terms and definitions, Laboratory organization, Tools and techniques, methods of sterilization. Role of Micro and macro nutrients, Vitamins and carbon source in tissue culture, Media preparation- pH, Temperature, Solidifying agents, Slant Preparations etc. Maintenance of cultures, Environmental Conditions, explants characteristics. Anther culture, ovary culture, Protoplast culture, embryo culture, endosperm culture, micro propagation and Somatic hybridization.

Unit VI: Ecology

- **The Environment:** Biotic and abiotic interactions. Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
- **Population Ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of meta-population – demes and dispersal, interdemic extinctions, age structured populations.
- **Ecosystem Ecology:** Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N and P); primary production and decomposition; structure and function of ecosystems: terrestrial and aquatic.
- **Community Ecology:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Unit VII: Tools and Techniques

- Microtomy and Micrometry, Microscopy, SEM and TEM, Spectrophotometer, GC, Electrophoresis, HPLC, radioactive techniques, Biostatistical applications in research. Remote sensing.

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NAME OF FACULTY : SCIENCE AND TECHNOLOGY

NAME OF THE COURSE – Ph.D. ENTRANCE TEST (PET) (w.e.f. 2024)

SUBJECT - MICROBIOLOGY

(2024)

Ph.D. Entrance test (PET) for Ph.D. in Microbiology

Unit 1: Fundamentals of Microbiology and Microbial diversity

A. Historical Background:

- a. Contribution of Robert Hook, Antony Van Leuwenhoek, Ernst Ruska
- b. Theory of spontaneous generation
- c. Golden era of Microbiology (1857-1914) - i) Germ theory of fermentation ii) Germ theory of disease
- d. Contribution of Martinus Beijerinck, Sergei Winogradsky, Louis Pasteur, Joseph Lister and Dmitri Ivanovski, Edward Jenner, Eli Metchnikoff, Salmon Waksman, Alexander Fleming. In development of applied microbiology.

B. Microbial Diversity –

- a. Definition, nomenclature rules and identification, hierarchical organization and the position of microbes in the living world.
- b. Classification systems – artificial and phylogenetic– dendrogram. Haeckel's three-kingdom classification, Whittaker's five-kingdom approach, and Three domain classification of Carl Woese., Bergey's manual of systematic and determinative bacteriology.
- c. Major characteristics used in taxonomy – morphological, physiological, metabolic, genetic and molecular characteristics, comparison of proteins, nucleic acid hybridization, nucleic acid sequence comparison, DNA and RNA homology, and G+C ratio.
- d. Significance of rRNA in microbial taxonomy, Numerical Taxonomy and Chemotaxonomy.

C. General Characteristics of Microorganisms

- a. I) Bacteria ii) Mycoplasma iii) Rickettsia iv) Actinomycetes v) Algae vi) Fungi vii) Viruses viii) Protozoa ix) Archaeobacteria
- b. **Cellular organization of prokaryotic and eukaryotic Cell**

Unit 2: Microbial genetics

- A) Gene, Genome, Genetic Code, Nucleoid, Cistron, Muton, Recon, Transposons.
- B) Types of DNA, DNA replication, Mutation and its types, mutagenic agents and repair, recombination,

- C) Types of RNA, RNA synthesis and processing, Protein synthesis and processing, Control of gene expression (Operon) at transcription and translation level
- D) Genetic Engineering: Tools, Construction and applications of Genomic libraries and cDNA libraries, Constructions of recombinant DNA, Selection and Detection of recombinant DNA, Applications of Genetic engineering in various sectors, Ethical and legal aspects of Genetic engineering.

Unit 3: Microbial physiology

A) Microbial growth and its types, environmental factors affecting growth, methods of measurement of growth,

B) Biomolecules: Classification, Structure and functions of

a) Carbohydrates b) Proteins c) Lipids d) DNA e) RNA f) Enzyme g) Vitamins h) Hormones

C) Microbial Nutrition:

Nutritional requirements of microorganisms ii) Nutritional types of Microorganisms based on Carbon and Energy source. Transport mechanism of Nutrients across the cell membrane, types of reserve food materials and their functions.

D) Bioenergetics: Carbohydrate catabolic pathways, EMP, HMP, ED, Phosphoketolase pathway, TCA cycle, and methylglyoxal bypass. Anaplerotic sequences, Substrate level Phosphorylation, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. ETC, theories of ATP formation.

Unit 4: Industrial and Pharmaceutical Microbiology

A) Bioreactor Design, types and Operation.

B) Development of microbial processing.

- a) Fermentation media
- b) Screening, strain improvement, scale up, inoculum preparation, stock culture maintenance, contamination problems.

C) Industrial production of:

- a) Streptomycin, Amylase, Vitamin B12, L-Lysine, Insulin
- b) Production and applications of biopolymers, Xanthan gum, dextran, pullulan, mannan, curdlan and Alginate.
- c) Production of Mushroom, production steps, harvesting and preservation,

nutritive value

d) Industrial production of distilled alcoholic beverages. Whisky, Brandy, wine and beer.

D) Downstream processing and Quality control.

E) a) Antibiotics and Synthetic Antimicrobial Agents

b) Mechanism of Action of Antibiotics:

c) Regulatory Practices, Biosensors and Applications in Pharmaceuticals

Unit 5: Environmental Microbiology

A) Environment and Ecosystems

B) Eutrophication Water pollution and its control

C) Characterization of Industrial wastes, Working of treatment systems and their analysis

D) Environmental control Bodies, State, National and International

E) Waste disposal control and regulations

F) Novel Methods of Pollution Control

G) Global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

Unit 6: Agricultural Microbiology

A) Soil environment: Physicochemical and biological properties, soil microorganisms and soil fertility, soil enzymes, organic matter decomposition, biogeochemical cycles-C, N, S and P. Recycling of Agriculture and animal waste (Composting, FYM, Green Manure, Vermicompost)

B) Microbial Biofertilizers and Biopesticides: – Types, Production and methods of Applications:

C) Development of genetically modified crops and microorganisms:

Unit 7: Immunology and Clinical Microbiology

A) Immunity: types and mechanism of immunity, Immune System, Organs and cells involved

B) Immunogenetics

a) Major histocompatibility systems:

b) Immunoglobulin gene structure

C) Clinical Immunology

1. Autoimmunity

2. Hypersensitivity

3. Transplantation immunology:

D) Immunization & Immunological Techniques: types of Vaccines, immunization schedule.

Unit 8: Virology

A) Classification and Morphology of Viruses and viral genomes

B) Cultivation, Purification and assay of viruses

C) Viral Multiplication

D) Pathogenesis of Viruses

E) Control of Viruses and Emerging Viral Infections

Unit 9: Food and Dairy Microbiology

A) Food as substrates for microorganisms.

B) Microbiology and spoilage of Food. General mechanism of food spoilage.

C) Microbial Food borne diseases, Food poisoning, infections, investigation of food born outbreaks, prevention and control

D) General principles underlying food preservation and different methods of food preservation.

E) Fermented Food products and their Production

F) Microbiology of Milk and milk products

G) Food laws and standards, Indian and international food safety laws.

H) Quality and safety assurance in food and dairy industry, Sanitation and regulation in food and dairy industry.

Unit 10: Microbial Techniques and Instrumentation

A) Microscopy:- Principle, construction, image formation, resolution and application of light, phase contrast, Bright field, dark field, Fluorescence, Scanning and Transmission electron microscopy.

B) Principle Methodology and applications of chromatography techniques: Gel filtration, ion exchange and affinity chromatography, thin layer and gas chromatography, High performance liquid chromatography

C) Principle, Methodology and Applications of Centrifugation: density gradient and ultra-centrifugation.

D) Principle of biophysical method for analyzing biopolymer structure:

E) Electrophoresis, Principle and application of Native, SDS Agarose and 2D gel

Electrophoresis, Blotting techniques



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Zoology PET-9 Syllabus

UNIT-I: Classification of animal kingdom:-Chordates and non-chordates

A. Non-chordata:-

- i. Concept of species and speciation.
- ii. Evolution of symmetry, segmentation and coelom in metazoa.
- iii. **Protozoa**:-Locomotion and reproduction in protozoa.
- iv. **Porifera**:-canal system and skeleton.
- v. **Coelelerata**:-Polymorphisn in coelelerata, coral reefs and there significances.
- vi. **Platyhelminthes and aschelminthes**:-Life cycle of *Fasciola hepatica*, *Teniasolium*, *Ascaries*, Parasitic adaptation, Pathology and control of helminthes- infecting man.
- vii. **Annelida**:-Segmentation in Annelida, Economic importance of Annelids.
- viii. **Arthropoda**:-Crustation larvae, mouth parts in insects (Cockroach, Honey bee, Butterfly, mosquito), Metamorphosis in insect, social life in termites and honey bees.
- ix. **Mollusca**:-Torsion and detorsion in gastropoda, respiration in Mollusca.
- x. **Echinodermata**:-Water vascular system, Echinoderm larva and their polygenic significance.

B. Chordates: -

- i. **Protochordata**:-Structural organization and affinities of *Balanoglossus*. Retrogressive metamorphosis in eurochordata, feeding mechanism in amphioxus.
- ii. **Pisces**:-Migration in fishes. Respiratory and mechanism of respiration in fishes. Receptor and effector organs in fishes. Morphometric characters in fishes.
- iii. **Amphibian**:-Parental care in amphibian, Neoteny, metamorphosis in frog.
- iv. **Reptilian**:-Significance of temporal vacuities in classification reptilians. Non-poisonous and poisonous snakes in India.
- v. **Aves**:-Bird migration, flight adaptation in birds.
- vi. **Mammals**:-Dentition in mammals. General characters of prtothenia, metathenia and Euthenia

Unit – II Animal Physiology

- i. **Blood and circulation**: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.
- ii. **Cardiovascular System**: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure.
- iii. **Respiratory system**: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.
- iv. **Nervous system**: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.
- v. **Sense organs** – Vision, hearing and tactile response.

- vi. **Excretory system:** Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.
- vii. **Thermoregulation:** Comfort zone, body temperature—physical, chemical, neural regulation, acclimatization.
- viii. **Stress and adaptation.**
- ix. **Digestive system:** Digestion, absorption, energy balance, BMR.
- x. **Endocrinology and reproduction:** Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation.

Unit-3 Cell biology and principles of Genetics

A. Cell Biology

- i. **Overview of Cells Prokaryotic and Eukaryotic cells, Virus**
- ii. **Plasma Membrane:** Singer & Nicholson's model of plasma membrane. An overview of active transport and passive transport, across membranes: Uniport, Antiport, Symport
- iii. **Endomembrane System:** Structure and Functions: Endoplasmic Reticulum, Golgi apparatus, Lysosome.
- iv. **Mitochondria:** Ultrastructure, Semi-autonomous nature, Endosymbiotic hypothesis functions.
- v. **Cytoskeleton:** Structure and Functions: Microtubules, Microfilaments, Intermediate filaments
- vi. **Nucleus:** Structure and functions of Nucleus, Nuclear envelope, Nuclear pore complex, Nucleolus, Chromatin: Euchromatin, Heterochromatin and nucleosome
- vii. **Chromosome:** Types of chromosomes, Acrocentric chromosome, metacentric chromosome, telocentric chromosome, acentric chromosome.
- viii. **Cell Division:** Cell cycle, Mitosis and Meiosis

B. Principles of Genetics

- i. **Mendelian Genetics and its Extension:**
Principles of inheritance—Laws of Mendelian Inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles; Gene Interactions: Supplementary, Complementary & Inhibitory interactions; Examples of Sex-linked, sex-influenced and sex-limited characters inheritance.
- ii. **Linkage, Crossing Over and Chromosomal Mapping:**
Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity; Somatic cell hybridization.
- iii. **Mutations:** Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method.
- iv. **Sex Determination:** Chromosomal mechanisms of sex determination in Drosophila and Human; Human Genetic Disorders: Mechanism, symptoms, treatment: Down's Syndrome, Klinefelter's Syndrome and Turner's Syndrome.
- v. **Extra-chromosomal Inheritance:** Extra-chromosomal inheritance with examples
- vi. **Polygenic Inheritance:** Polygenic inheritance with suitable examples; simple numerical.

- vii. **Recombination in Bacteria and Viruses:** Conjugation, Transformation, Transduction with examples; Complementation test in Bacteriophage.
- viii. **Transposable Genetic Elements:** Transposons in bacteria

Unit- 4 Applied Zoology

- i. **Introduction to Aquaculture:** Fish Culture, Breeding Pond, Fish Seed, Hatching Pond. Transport of fish fry to rearing ponds. Harvesting, preservation of fish. By products of fishing industry and common fish diseases; Prawn culture: Culture of freshwater prawn
- ii. **Fisheries:** Inland Fisheries; Marine Fisheries Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations. Application of biostatistics in Fishery: morphometric analysis of length, weight to determine mean, mode, variance and standard deviation.
- iii. **Apiculture:**Species of honeybees in India. Life history of Apis. Methods of Bee keeping. Bee products and their uses. Natural enemies and their control. Medicinal value of honey; Importance of bee colonies in crop pollination.
- iv. **Lac culture:**Lac insect and its life cycle, Cultivation of lac insect, host plants, processing and uses of lac.
- v. **Sericulture:**Types of silk; Silkworms and their host plants; Mulberry silkworm culture; Life history of silkworm; Natural enemies and their control
- vi. **Dairy Management:**Introduction to common dairy animals. Techniques of dairy management. Milk and milk products. Cattle Diseases.
- vii. **Poultry Management:**Types of breeds. Rearing method. Diseases and control measures. Housing and Equipment, Deep litter System, Laying cages, Methods of brooding and Rearing, Feed formulations for chicks, Diseases of fowl. Nutritive value of egg and meat. Incubation and hatching of eggs.
- viii. **Recent advances applied zoology:** Zebrafish as a model organism in research, transgenic animals (Salmon, chicken, goat, pigs) & its significance.

Unit- 5 Ecology, Ethology

A) ECOLOGICAL PRINCIPLES:

- 1) **Habitat, Niche & Population Ecology:** Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement; Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation
- 2) **Species and Community Ecology:** Types of interactions, inter-specific competition, herbivory, carnivory, symbiosis; Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotone.
- 3) **Ecosystem & Ecological Succession:** Types; mechanisms; changes involved in succession; concept of climax; Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).
- 4) **Biogeography & Applied Ecology:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India; Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Unit : 6 Evolution And Behaviour:

- 1) **Emergence of Evolutionary Theories:** Lamarck; Darwin—concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; evolutionary synthesis.
- 2) **Origin of cells, Paleontology and evolutionary history:** History of ideas, Abiotic synthesis of organic molecules, polymers & first cell; concept of Oparin and Haldane; experiment of Miller; evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; major groups of animals; stages in primate evolution including *Homo*.
- 3) **Molecular Evolution & The Mechanism(s):** Concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification; protein and nucleotide sequence analysis; origin of new genes and proteins; gene duplication and divergence; Population genetics: populations, gene pool, gene frequency; Hardy-Weinberg law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; adaptive radiation and modifications; Reproductive isolation and modes of speciation; co-evolution.
- 4) **Brain, Behavior and Evolution:** Approaches and methods in study of behavior; historical contributions in behavior; proximate and ultimate causation; altruism, group & kin selection, reciprocal altruism; Innate & Learned behaviors; parental care; migration, orientation and navigation; Associative learning, classical and operant conditioning, Habituation, Imprinting, Foraging & dance language in honey bee and its advantages; mating systems: Intra-sexual selection (male rivalry), Intersexual selection (female choice); Sociobiology; biological clocks & chronobiology.

Unit- 7 Recent Techniques In Biology

A. Molecular Biology and Recombinant DNA methods:

- i. Isolation and purification of RNA , DNA (genomic and plasmid) and proteins,different separation methods. Analysis of RNA, DNA and proteins by one and two dimensional gelelectrophoresis, Isoelectric focusing gels.
- ii. Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors.
- iii. Isolation of specific nucleic acid sequences. Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YACvectors.
- iv. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms.
- v. Protein sequencing methods, detection of post translation modification of proteins.
- vi. DNA sequencing methods, strategies for genome sequencing.
- vii. Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques.
- viii. Isolation, separation and analysis of carbohydrate and lipid molecules RFLP, RAPD and AFLP techniques.

B. HistochemicalAndImmunotechniques

Antibody generation, Detection of molecules using ELISA, RIA, western blot,immunoprecipitation, fluocytometry and immunofluorescence microscopy,detection of molecules in living cells, in situ localization by techniques such as FISHand GISH.

C Biophysical Method:

- i. Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy. Molecular structure determination using X-ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.
- ii. **Electrophysiological methods:** Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.
- iii. **Radiolabeling techniques:** Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

D. Microscopic techniques:

Visualization of cells and sub cellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

Unit- 8 Computational Biology

A. Measures of Central Tendency and measures of dispersion: Data representation and plotting, Meaning and Definition of Arithmetic mean, median and mode. **B. Absolute and relative measures of dispersion:** Range and its coefficient, Mean deviation and its coefficient, Quartile deviation and its coefficient. Standard Deviation and Coefficient of Variation **C. Measures of Central Tendency and measures of dispersion:** Data representation and plotting, Meaning and Definition of Arithmetic mean, median and mode. **D. Correlation and Regression:** Meaning and its type, Scatter diagram, Karl Pearson coefficient of correlation, Spearman's Rank correlation coefficient, Linear Regression

E. Discrete and Continuous Distribution: Binomial distribution, Poisson distribution, Poisson approximation to Binomial distribution, Joint distribution of two variables, Normal and Standard normal distribution.

F. Tests of Hypotheses: Formulation of Hypothesis Simple and Composite, Type I and Type II errors, Power of a test, Significance of a test, P-value, Testing Normal, Chi-square, t test and F-test, Z test Nonparametric test.

Unit-9 Developmental Biology

A) Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

- B) Gametogenesis, fertilization and early development:** Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac, zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals;
- C) Morphogenesis and organogenesis in animals:** Cell aggregation and differentiation in and pattern formation in *Drosophila*, amphibia and chick; organogenesis –limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Unit-10 Molecular Biology

1. Organization of DNA; Evidences for DNA as a genetic material- Transformation, Transduction and Conjugation.
2. Replication of DNA; DNA damage and repair mechanism.
3. Protein Synthesis a) Transcription - Process of transcription in prokaryotes, RNA polymerases, Post transcriptional modifications in RNA.
4. Translation –Activation of amino acids, Binding or transfer of amino acid to t RNA. Initiation, Elongation, Termination
5. Genetic Code -Properties of Genetic Code, Codon assignments; Initiation codon; Termination codon; Codon and anticodon pairing; Wobble hypothesis.
6. Regulation of gene expression –With reference to Lac- operon concept

List of Reference Books

1. Invertebrate Zoology- (W.B. Saunders Co.) – Barnes R.D.
2. Treatise in Zoology Sedgwick Vol III
3. Modern Text Book of Zoology, Invertebrates – R.L.Kotpal.
4. Life of Invertebrates – S.N. Prasad, Vikas publishing House, New Delhi.
5. Practical Zoology, Invertebrates- S.S. Lal.
6. Bioinformatics- Murti, Himalaya Publications.
7. Introduction to Bioinformatics Attwood Pearson Education Delhi
8. Parasitology-Chandler, Allied Agency, Kolkata.
9. Essentials of Parasitology – Gerald D. Smidh, South Delh.
10. Introduction to Biostatistics Pranab Kumar Banerjee S. Chand and Company. New
11. Evolution : Mark Ridley Blackwell Publishing In India marketed by John Wiley and Sons.
12. Cell and Molecular Biology, 8th Edition, De. Robertis EDP and De
13. Robertis Jr. EMF, Lippincott Williams and Wilkins, Philadelphia, ’
14. Cell Biology, C.B. Powar, Himalaya Publication House.
15. Cell and Molecular Biology, E.J. Dupraw, Academic Press, NewYork.
16. Cell Structure and Function – A. G. Loewy, P. Siekevitz, J. R. Meninger
17. & J. A. N. Gallant, Saunder College, Philadelphia.
18. Molecular Biology of the Cell – 3rd Edition, Bruce Alberts, Dennis Bray,
19. Julian Lewis, Martin Raff, Keith Roberts & James D. Watson, Garland

20. Publishing, New York.
21. Elements of Biotechnology – P. K. Gupta, Rastogi Publications.
22. Gene V & VI, 1994, Lewin B., Oxford University Press, Oxford.
23. Prawn and Prawn Fishery of India – Kurian.
24. Fish Culture – K. H. Alikuhni.
25. Fish Culture – Lagler.
26. Fishes of India. – Zingran
27. Manual of sericulture – Krishnaswamiet. al.
28. Introduction to sericulture – Ganga and Shetty.
29. Statistical Methods (Volume 1 and 2) (1st Ed.), N. G. Das, Tata McGraw-Hill, 2009
30. Fundamentals of Biostatistics (6th Ed.), Bernard Rosner, Thomson Brooks/Cole,
31. Primer of Biostatistics. McGraw-Hill Medical, 2011. ISBN: 9780071781503.
[Preview with [Google Books](#)]
32. Gupta and Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and sons, 4th Edition, New Delhi, 2019.
33. Hooda, "Statistics for Business and Economics", Macmillan, 3rd Edition, India, 2003.
34. John.E.Freunds, "Mathematical statistics with applications", Pearson Education, 8th Edition, New Delhi, 2013.
35. Levin and Rubin, "Statistics for Management", Pearson Education India, 7th Edition, New Delhi, 2013.
36. An Introduction to Embryology 2003, Balinsky B.L., Saunders College, Philadelphia.
37. Developmental Biology; Patterns/Principles/Problems, 1982, Saunders J. W. Collier MacMillan, Publishers, London.
38. Developmental Biology, 2004 , 3rd Edition, Gilbert S.F. Saunder Associates Inc. U.S.A.
39. Developmental Biology, 1992 3rd edition, Browder L.W. Erickson C.A. & Williams, R.J. Saunders College, Publications, London.
40. A Text Book of Embryology, Dr. Puranik P. G. , S. Chand & Co.
41. Developmental Biology, 1984, Browder L.W. , Saunders College Publications, U.S.A.
42. Development of Chick embryo, 1972, Lillie.
43. Outlines of comparative anatomy, Romer & Parsons, Central Book Depot, The Vertebrate Body (Saunders).
44. Biology of Vertebrates Walter & Sayles; (McMillan).
45. Modern Textbook of Zoology, R. L. Kotpal, Rastogi Publications, Meerut.
46. The Life of Vertebrates, 3rd Edition, 1993, J. Z. Young E. L. B.S. Oxford.
47. Chordate Zoology – E.L. Jordan, S. Chand & Co., New Delhi.
48. The Phylum Chordata – 1987, H.H. Newman, Distributor SatishBook Enterprise, Agra.
49. General and Comparative Physiology – Hoar (Prentice Hall).
50. Animal Physiology – Nelson (Cambridge).
51. Comparative Animal Physiology – Prosser (Satish Book Enterprise).
52. Endocrinology – Hadley Pearson Education Delhi
53. General Endocrinology – Bagnara & Turner (W.B. Saunders)
54. Ecology – Odum (Amerind) 7. Limnology – Welch (McGraw Hill)
55. Introduction to Environmental Science – Y Anjaneyulu (B.S. Publications)
56. Animal Physiology – Adaptation and Environmental – Schiemdt Nielson (Cambridge)
57. Physiology : A regulatory systems approach – Strand F.L. (McMillon Publications Co.).

58. Environmental and Metabolic Animal Physiology – Prosser C.L. (Wiley – Liss Inc.)
59. Environment Physiology- Willmet P.G., Stone & Johnson (Blackwell Science, Oxford).
60. Physiological Animal Ecology – Loan G.N. (Longman Harlow, UK)